

AD-A282 873



MENTATION PAGE

Form Approved

OMB No. 0704-0188

Estimated average time per response including the time for reviewing instructions, searching existing data sources, gathering and reviewing the collection of information, sending comments regarding this burden estimate or any other aspect of this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

REPORT DATE

July 31, 1994

3. REPORT TYPE AND DATES COVERED

Annual Report 10/1/93-9/30/94

4. TITLE AND SUBTITLE

Nonlinear Problems in Fluid Dynamics and Inverse Scattering
 --Propagation and capturing of singularities in problems
 of fluid dynamics and inverse scattering

5. FUNDING NUMBERS

①

6. AUTHOR(S)

Gregory Beylkin

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Program in Applied Mathematics
 University of Colorado, Boulder
 Campus Box 526
 Boulder, CO 80309-0526

8. PERFORMING ORGANIZATION
REPORT NUMBER

1534619

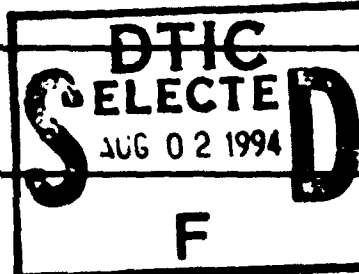
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Department of Navy
 Office of Naval Research
 Code 1111
 800 North Quincy St.
 Arlington, VA 22217-5000

10. SPONSORING/MONITORING
AGENCY REPORT NUMBER

N00014-94-1-0194

11. SUPPLEMENTARY NOTES



12a. DISTRIBUTION/AVAILABILITY STATEMENT

This document has been approved
 for public release and sale; its
 distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Research investigations and development of the fast adaptive algorithms using orthonormal bases with controlled localization in the time-frequency domain (e.g. wavelets) have been successful and several new algorithms have been developed. Among the results is the Unequally Spaced Fast Fourier Transform (USFFT) algorithm and a new approach to numerical homogenization.

94-24215



396

94 8 01 005

14. SUBJECT TERMS

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION
OF REPORT18. SECURITY CLASSIFICATION
OF THIS PAGE19. SECURITY CLASSIFICATION
OF ABSTRACT

20. LIMITATION OF ABSTRACT

ONR Grant: N00014-94-1-0194

Nonlinear Problems in Fluid Dynamics and Inverse Scattering

Principle Investigator: Gregory Beylkin

Subtitle: Propagation and capturing of singularities in problems of fluid dynamics and inverse scattering

Program Manager: Dr. Reza Malek-Madani

Annual Progress Report

Research investigations and development of the fast adaptive algorithms using orthonormal bases with controlled localization in the time-frequency domain (e.g. wavelets) have been successful and several new algorithms have been developed. Among the results is the Unequally Spaced Fast Fourier Transform (USFFT) algorithm and a new approach to numerical homogenization.

Research Activities:

Using a Battle-Lemarie scaling function we have constructed a fast algorithm to evaluate the Fourier transform of generalized functions. In particular, we have developed an algorithm for the Unequally Spaced Fast Fourier Transform and tested its performance in dimensions one and two. Also we have a new algorithm to evaluate the Fourier Transform of an image, taking into account the discontinuities within the image. Our approach also has implications for numerical solutions of PDE's which we plan to investigate further.

Jointly with Mary E. Brewster, we have constructed a numerical scheme for homogenization of linear differential and difference equations via multiresolution analysis. This work has a potential for a significant impact by permitting us to construct the equations for computing the projection on a sparse scale of the solution of equations given on very fine scales.

Jointly with John Dunn and David Gines, we developed a practical hybrid method for solving Static and Quasi-Static problems in Electromagnetics using wavelets.

Jointly with Bruno Torresani, we developed a method of applying operators in wavelet bases. This method is different from both standard and non-standard forms that have been developed previously and is very efficient for convolution operators, e.g. the Hilbert transform.

A new efficient method for design of FIR Approximation of IIR Filters has been developed. We use a "non-traditional" approach to this problem.

The work with James Keiser on solving partial differential equations in wavelet bases has continued. The results will be published shortly.

The work with Robert Cramer on the multidimensional algorithms for the fast evaluation of a class of integral operators on functions is producing results. We also expect to release these results shortly.

Published Papers:

"Wavelets and Fast Numerical algorithms", G. Beylkin, Proceedings of Symposia in Applied Mathematics, vol. 47, 1993

Preprints:

"On Factored FIR Approximation of IIR Filters", G. Beylkin, November 1993, PAM Report #181

"Implementation of Operators Via Filter Banks, Autocorrelation Shell and Hardy Wavelets", G. Beylkin and B. Torresani, February 1994, PAM Report #185

"A Multiresolution Strategy for Numerical Homogenization", M.E. Brewster and G. Beylkin, March 1994, PAM Report #187

"Order N Static and Quasi-Static Computations in Electromagnetics Using Wavelets", G. Beylkin, J. Dunn, and D. Gines, April 1994, PAM Report #189

"On Fast Fourier Transform of Functions With Singularities", G. Beylkin, June 1994, PAM Report #195

"Fast and Accurate Computation of Fourier Transform of an Image", G. Beylkin, July 1994, PAM Report #206

Accession	
NTIS	
DTIC	
Unannounced	
Justification	
By	
Distribution /	
Availability	
Dist	
A-1	